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Synthesis, Structural Elucidation and Photocatalytic Studies of Some 4-Aminoantipyrine Based Ruthenium (III) Complexes

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Abstract

Photo catalytic studies are considered as the effective process of organic pollutants degradation, which decrease the impacts on human health and the environment. The present study was conducted to evaluate the photo catalytic activities of some 4-aminoantipyrine based Ru(III) complexes against methylene blue dye. A series of five novel Schiff base ruthenium complexes (RuL_2Cl_2) have been synthesized by the reaction between five types of 4-aminoantipyrine derived Schiff base ligands and ruthenium trichloride by direct condensation method. The synthesized ligands and metal complexes were characterized using analytical and various spectral techniques. UV-light is used to calculate the rate of photo catalytic degradation of methylene blue using above mentioned metal complexes. Increase in the amount of catalyst, increases the degradation because it increases the number of active sites on the catalysts surface. Furthermore increase may cause the accumulation of free catalyst and also increase the opacity and decreases UV light penetration. The formation of hydroxyl radicals are the cause for successful degradation of methylene blue dye. The synthesized Ru(III) complexes show highest percentage of degradation on photo catalytic activity.

Keywords: *4-aminoantipyrine; Photo catalytic activity; Ruthenium(III) complexes.*

1. INTRODUCTION

Schiff bases derivatives prepared from 4-aminoantipyrine show wide variety of applications in many fields such as biological, inorganic and analytical chemistry[1]. Recent studies confirmed that ruthenium complexes act as a good catalyst for the oxidation of organic compounds [2]. The developing environmental restrictions to reduce pollution in industrial processes have initiated the development of substitute technologies as replacement to the conventional and harmful approaches in catalysis [3] water pollution is a burning problem all over the world. Presence of toxic dye materials in water may beharmful to animals and plants [4]. Disinfection of water is one of the applications of photocatalytic activity.

2. MATERIALS & METHODS

2.1 Synthesis of Schiff base

An alcoholic solution of 4-aminoantipyrine was added to an alcoholic solution of higher amides. The solution was stirred vigorously and refluxed for 5 h and allowed to cool. The solid intermediate was added to an alcoholic solution of phenylenediamine. The mixture was refluxed and poured in to crushed ice. The brown solid ligand (L) product was separated. It was filtered and recrystallized from alcohol [5]. The synthesized ligand on condensation reaction with ruthenium trichloride forms RuL^1Cl_2, RuL^2Cl_2, RuL^3Cl_2, RuL^4Cl_2 and RuL^5Cl_2 complexes.

2.2 Photo catalytic activity

Photocatalytic decomposing of methylene blue (MB) was designed to examine the recycling property of sample under UV light irradiation, the light source was provided by a 300 W ultraviolet lamp. The photocatalytic experiment was performed by the reaction between 50 mg of prepared sample added into MB aqueous solution of 100 mL (0.5 mg/L). After ultraviolet light irradiation, the suspension was stirred in the dark for 20 min to achieve the equilibrium between adsorption and desorption. During photocatalytic reaction, the solution of 5 mL was sampled and centrifuged at 20 min intervals. During irradiation, 5.0 mL of the suspension was taken out and centrifuged (10000 rpm, 2.0 min) to remove the photocatalyst before measurement. The supernatant wasthen monitored by an UV-vis spectrophotometer at the characteristic absorption of MB (662 nm) [6].The photocatalytic efficiency (%) was calculated using the formula:

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$$\% \text{ Degradation} = \frac{(A_0 - A_t) \times 100}{A_0}$$

Where A_0 and A_t are the absorbance of MB solution before and after the photocatalytic reaction.

3. RESULTS

The photocatalytic activity of the prepared samples were evaluated by degradation of MB under ultraviolet light irradiation ($\lambda < 400$ nm) with different intervals of time. The irradiation time photocatalytic degradation of MB was calculated from 0 to 90 min. with concentration 40mg/l at neutral pH.It was observed that RuL^1Cl_2, RuL^2Cl_2, RuL^3Cl_2, RuL^4Cl_2 and RuL^5Cl_2 complexes give degradation 69.7, 70.0, 78.5, 80.7 and87.3 respectively. It is clear that RuL^5Cl_2complex shows maximum degradation as compared to the other compounds. In general, increase in the amount of catalyst, increases the degradation because it increases the number of active sites on the catalysts surface (John and Joseyphus, 2019). Metal complexes absorb photons when they are irradiated with sunlight. The difference in charges increases the photocatalytic activity. Here Ru(III) complexes produced –OH radicals during the reaction. Formations of these radicals are the reason for the colour change of MB. The mechanism for the reaction (Krishna *et al.* 2013) is given below.

$$[RuLCl_2] + \text{UV-light} \longrightarrow [RuLCl_2]^* + {}^3O_2 \longrightarrow OH^-$$

$$OH^* + \text{Dye} \longrightarrow \text{Oxidative products}$$

4. CONCLUSION

4-aminoantipyrine derived Ru(III) complexes are synthesized and characterized by analytical and spectral techniques. The photocatalytic degradation of methylene blue using synthesized complexes under UV-light was successfully carried out. The degradation of the dye was done by the formation of hydroxyl radical. The increasing order of degradation of Ru(III) complexes are given by $RuL^1Cl_2 < RuL^2Cl_2 < RuL^3Cl_2 < RuL^4Cl_2 < RuL^5Cl_2$

REFERENCES

Deshmukh, P., P. K Soni, A. Kankoriya, K. Anand, R. Dixit. Int. J. Pharm. Sci. Rev. Res. 2015, 34, 162.

John, L., R.S Joseyphus, I.H Joe. Journal of Coordination Chemistry 2019, 72, 1

Krishna, P. M., A.N. Reddy, K.H. Reddy. International Journal of ChemTech Research, 2019,12, 171.

Krishna, P. M., N.B.G. Reddy, N.Kottam, B.C Yallur, H. R. Katreddi. The scientific world journal. 2013, 8, 1-7

Shoair, A. F., A.A. El-BindarySpectrochimicaActa Part A: Molecular and Biomolecular Spectroscopy, 131, 2014 490–496

Suresh, M. S., V. Prakash. E. J. Chem, 2011, 8, 1408

Verma, S., S. L. Jain,BirSainChemCatChem 2011, 3, 1329 – 1332.